Assistive Camera Control

ECE-403

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1 Introduction

Our design project is an assistive camera device. This device is designed to help a person to easily control the zoom on a telephoto lens. The device will be mounted on the camera, and will be controlled by a computer through a switch interface/scanning system. Also upon requested we will be increasing the speed for the pan/tilt system on the camera to make for a faster camera system for the client.

2. Previous Work and Products

Existing products that are similar to the assisted camera control product that we are revitalizing include a couple products that are online. There are a couple patents out there that claim you can connect a camera to their program but there main purpose is that quadriplegics can run things on their computer such as writing word documents, searching the web, and sending emails. Here are a couple products that are hands free.

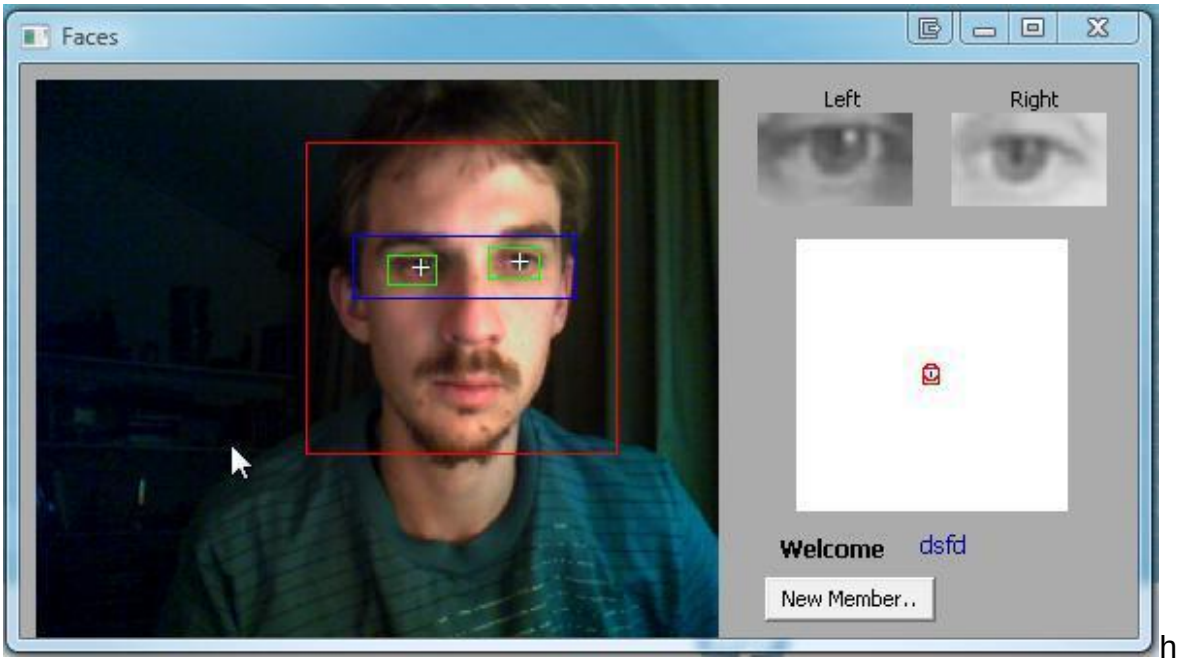
2.1 Eyegaze Edge Communication System

The Eyegaze Edge Communication System is an eye operated communication and control system that empowers people with disabilities to communicate and interact with the world around them. With the Eyegaze system, a person can speak, write, interface with a PC or Mac, use the internet and even control systems in the home or office. The Eyegaze system is available as a

portable tablet that can be mounted on a wheelchair or as a workstation desktop system.

This product is similar to the assisted camera control in the way that it can control anything on the computer, but the Eyegaze system can control everything with eyesight and eye movement. The assisted camera control does everything with the patients head which can get tiring. The eyegaze promises that the fatigue of your eyes has no viable downfall to it.

2.2 The Camera Mouse



The program was developed at Boston College to help people with disabilities use the computer. The main audience for this program is people who do not have reliable control of a hand but who can move their head. People with Cerebral Palsy, Spinal Muscular Atrophy, ALS, Multiple Sclerosis, Traumatic Brain Injury, various neurological disorders use this program and its predecessors to run all types of computer software.

Just like the Eyegaze system the camera mouse can only control programs on the computer and we need a program that can actually control the camera.

For our design it helps out that our project is already set up in terms of the mounting of the camera which is already on the wheelchair and the program is already set up for the user to use the camera but we are making changes to make it more user friendly and to do it in faster time so the user can make videos and capture more photos.

3. Design Options

3.1 Motors

There are two main options to consider when choosing a motor to control the zoom of the lens. These options are DC or stepper motors.

3.1.1 DC Motor

DC motors would be a good choice to drive a camera lens due to their ease of speed and torque control. With a simple H-Bridge one could control speed, torque and direction of a DC motor. However, it might be hard to control the motor to precise angles that would be required to control a camera lens to specific zoom settings.

3.1.2 Stepper Motor

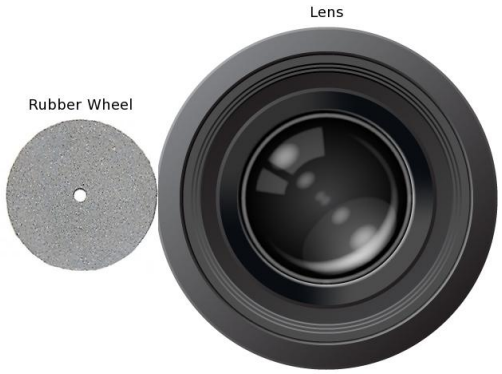
A stepper motor would easily allow us to control the angle of the camera lens. It is also easy to control the speed and direction of a stepper motor. Due to their precise angular control, stepper motors are used in many applications that need precise control, such as speedometers. This feature of the stepper motor makes it an ideal option for our application.

3.2 Drive Configurations

When considering a way to couple the motor to the lens we came up with two configurations to consider: Belt drive and wheel drive.

3.2.1 Wheel Drive

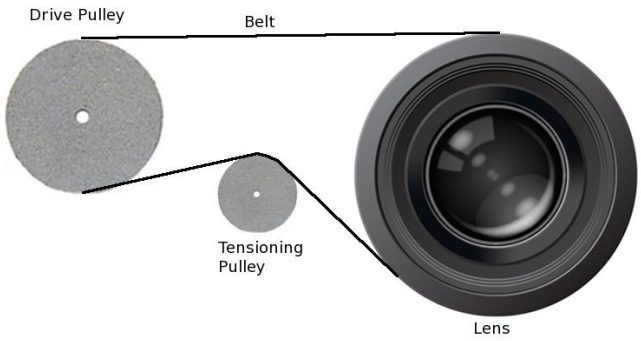
This configuration would be a rubber wheel mounted on the shaft of the drive motor. This rubber wheel would then be mounted against the camera lens itself to drive the lens as shown in the diagram below.



An advantage of this configuration is its simplicity, but due to the small contact area between the lens and the rubber wheel, slipping might be an issue.

3.2.2 Belt Drive

An alternative to the previous configuration would be a belt drive. This design would have a pulley mounted on the shaft of the drive motor and a belt coupling the drive motor pulley to the camera lens. Tensioning of the belt will be done with an adjustable tensioning pulley. The configuration is shown in the diagram below.



This configuration has several advantages, such as being able to mount the drive motor further away from the camera, and easy adjustment with a tensioning pulley. But the main advantage is the lower possibility of slipping.

3.3 Microcontrollers

In order to interface the motors with the computer, we need to communicate our intentions to the motor control system. The most straightforward way to do this is with a microcontroller, which leaves many options available.

3.3.1 PIC18F4620

The PIC is an option that could be used for the microcontroller. It is easily available, as it is actively used at NDSU. This also gives us an advantage in familiarity with the platform, and the available compilers and debugging capabilities at NDSU. It also has low power and sleeping capabilities so that the circuit can disable as much as possible to help keep battery usage from the wheelchair at a minimum. The only real downside could be its somewhat higher cost at $7 compared to the competitors.

3.3.2 Atmel ATMega328P-PU

The AVR chip is another widely used cheap microcontroller. At $4 it is cheaper than the PIC, but it also possesses fewer I/O pins, interrupt capabilities, and memory. It also has an entire IDE available for free from Atmel, but requires the use of either an Arduino or Atmel's ISP Programmer in order to program, which would require $60 of setup. The ATMega possesses similar current and low power capabilities as the PIC.

3.4 Software

The software used to control the system is ultimately what Sady interfaces with, and it is an important piece of user accessibility. We could have perfect hardware, but if the interface is not beneficial for Sady the project cannot function correctly.

3.4.1 New software

One option is for us to entirely rewrite the software Sady uses to add our additional functionality into the software. This gives us the advantage in having full control over how the functionality is implemented and allows us to customize everything to Sady's liking. The downside is Sady is already familiar and used to her current system, so switching it out will cause her an unnecessary burden in having to learn the new software.

3.4.2 Retrofit old software

Another option is to add the zoom functionality and variable speed tilt and zoom to the program already in use. This requires modifying the current software for use with our addition, which could potentially introduce bugs in already working software. The benefit to Sady would be a familiar interface, which allows her to more easily use the software. This also may require less overall time, as a lot of the functionality is already implemented in the current software, and would not need to be rewritten.

4. Approach

We chose after careful consideration that the best options were to use stepper motors for the zoom control which maximises focal control. We also chose to use a belt drive because it mechanically will provide a smoother, faster, and superior control of the zoom. In the software realm, we're sticking with the PIC because its easily available and NDSU possesses the necessary tools to debug and compile the code. We also chose to retrofit the software as it is the easiest option for Sady's usability.

5. Budget

Item	Vendor	PN#	Qty.	Price
Stepper Motor	Digikey		1	$35
PIC18F4620	Digikey	PIC18F4620	1	$7.94
PCB	Advanced Circuits	N/A	1	$50
TIP-31C NPN Transistor	Digikey	TIP31CFS-ND	4	$0.54
Various passive components	Jeff	All	A couple	$2.00

6. Timeline

Name	Weeks	Who
Project approval	1	all
Requirements capture meeting	3	all
Requirements capture document	4	all
Req cap: intro,requirements, summary	4	all
Req cap: design, budget, previous work, timeline	5	all
Test current setup from client	6,7	all
Order parts needed to make additions	6,7	all
Design new motor control	8	Lance, David
Design microcontroller interface	8	Steven, Lance
Begin programming	8	Steven
Breadboard stepper motor and PIC	9,10,11	all
Power requirements	9,10,11	all
Progress Report	12	all
>> Progress on software	12	Steven
>> Progress on stepper motor control	12	Lance, David
>> Progress on pan/tilt control	12	all
Revise schematic design	13	all
Breadboard and test new design	14	all
Start PCB layout	15	all
Prepare for presentation	15	all
PRESENT	16	all
Finalize initial PCB layout	17 (Semester 2)	Steven, Lance
Finalize power supply design	18	Lance, David
Work on code	18	Steven
Initial wheelchair mounting test	19	All
Revise schematic	20	Steven, Lance
Software usability testing	21	Steven
Final meetings with client	22-23	All
Finalize motor control	24-26	Lance, David
Polish software	27	Steven
Finalize PCB	27-28	All
Final assembly	29-30	All
Final testing and tweaking	31	All
Delivery	32	All

8. Summary

We have shown that we have many options to consider for our motor control and for our programming of the camera zoom and maybe some touch ups on the mounting and construction of the project at hand. All of our decisions for this project involve what we believe is necessary to construct the best possible outcome for our user. Our goal in this project is to maximize the speed and every possible desired direction for the camera, and also to make user friendly controls to be able to zoom the camera in and out to get the best viable zoom angles. All of this provided with the available budget.

We will spend the following semester building and maximizing the old product to come up with a necessary prototype to be able to show the user what could possible make the product better. The assisted camera control that we provide for the user will able to hopefully provide quick enough production to make their own videos and professional
photos.